CLAIMS

What is claimed is:

1. A digital baseband (DBB) transmitter for transmitting at least one wireless communication signal to a base station (BS) which is configured to generate a transmit power control (TPC) signal in response to receiving the wireless communication signal, the DBB transmitter comprising:

(a) a digital pre-distortion compensation module having real and imaginary signal paths which are configured to receive and process respective real and imaginary signal components used to generate the wireless communication signal;

(b) an analog radio transmitter including a power amplifier (PA), the analog radio transmitter being configured to receive the processed real and imaginary signal components and, in response, generating a communication signal which is input to the PA, the PA being configured to amplify the generated communication signal, wherein the amplified communication signal is emitted from the DBB transmitter as the wireless communication signal; and

(c) a controller in communication with the digital pre-distortion compensation module and the PA, the controller being configured to control the characteristics of the wireless communication signal based on the TPC signal generated by the BS.

2. The DBB transmitter of claim 1 further comprising:

(d) a modem having real and imaginary signal paths and being configured to generate the real and imaginary signal components, receive the TPC signal and to pass the TPC signal to the controller.

3. The DBB transmitter of claim 2 further comprising:

(e) a first low pass filter (LPF) which couples the real signal path of the modem to the real signal path of the digital pre-distortion compensation module; and

(f) a second LPF which couples the imaginary signal path of the modem to the imaginary signal path of the digital pre-distortion compensation module.

4. The DBB transmitter of claim 3 wherein the controller includes a TPC mapping unit which receives the TPC signal from the modem, the TPC mapping unit being configured to output a first mapped TPC signal to the digital pre-distortion compensation module and a second mapped TPC signal to the PA.

5. The DBB transmitter of claim 4 wherein the digital pre-distortion compensation module comprises:

(i) a power estimation unit coupled to each of the real and imaginary signal paths, the power estimation unit being configured to generate a power estimation signal based on the magnitude of the real and imaginary signal components;

(ii) a first multiplier being configured to multiply the power estimation signal with the first mapped TPC signal to generate a first resulting product signal;

(iii) at least one look up table (LUT) being configured to generate an amplitude compensation signal in response to receiving the first resulting product signal; and

(iv) a phase distortion compensation unit being configured to generate a phase compensation signal in response to receiving the first resulting product signal.

6. The DBB transmitter of claim 5 wherein the digital pre-distortion compensation module further comprises:

(v) a second multiplier being configured to multiply the amplitude compensation signal with the real signal component to generate a second resulting product signal;

(vi) a first adder being configured to add the second resulting product signal to the real signal component to generate an amplitude compensated real signal component;

(vii) a third multiplier being configured to multiply the amplitude compensation signal with the imaginary signal component to generate a third resulting product signal; and

(viii) a second adder being configured to add the third resulting product signal to the imaginary signal component to generate an amplitude compensated imaginary signal component.

7. The DBB transmitter of claim 6 wherein the digital pre-distortion compensation module further comprises:

(ix) a fourth multiplier being configured to multiply the phase compensation signal with the amplitude compensated real signal component to generate a fourth resulting product signal;

(x) a third adder being configured to add the fourth resulting product signal to the amplitude compensated imaginary signal component;

(xi) a fifth multiplier being configured to multiply the phase compensation signal with the amplitude compensated imaginary signal component to generate a fifth resulting product signal; and

(xii) a fourth adder being configured to subtract the fifth resulting product signal from the amplitude compensated real signal component.

8. The DBB transmitter of claim 5 wherein the amplitude compensation signal is used by the digital pre-distortion compensation module to correct at least one impaired amplitude characteristic associated with the PA.

9. The DBB transmitter of claim 5 wherein the phase compensation signal is used by the digital pre-distortion compensation module to correct at least one impaired phase characteristic associated with the PA.

10. The DBB transmitter of claim 4 wherein the second mapped TPC signal is used to adjust the gain of the PA such that the PA does not operate in a nonlinear fashion.

11. A wireless transmit/receive unit (WTRU) for transmitting at least one wireless communication signal to a base station (BS) which is configured to generate a transmit power control (TPC) signal in response to receiving the wireless communication signal, the WTRU comprising:

(a) a digital pre-distortion compensation module having real and imaginary signal paths which are configured to receive and process respective real and imaginary signal components used to generate the wireless communication signal;

(b) an analog radio transmitter including a power amplifier (PA), the analog radio transmitter being configured to receive the processed real and imaginary signal components and, in response, generating a communication signal which is input to the PA, the PA being configured to amplify the generated communication signal, wherein the amplified communication signal is emitted from the WTRU as the wireless communication signal; and

(c) a controller in communication with the digital pre-distortion compensation module and the PA, the controller being configured to control the characteristics of the wireless communication signal based on the TPC signal generated by the BS.

12. The WTRU of claim 11 further comprising:

(d) a modem having real and imaginary signal paths and being configured to generate the real and imaginary signal components, receive the TPC signal and to pass the TPC signal to the controller.

13. The WTRU of claim 12 further comprising:

(e) a first low pass filter (LPF) which couples the real signal path of the modem to the real signal path of the digital pre-distortion compensation module; and

(f) a second LPF which couples the imaginary signal path of the modem to the imaginary signal path of the digital pre-distortion compensation module.

14. The WTRU of claim 13 wherein the controller includes a TPC mapping unit which receives the TPC signal from the modem, the TPC mapping unit being configured to output a first mapped TPC signal to the digital pre-distortion compensation module and a second mapped TPC signal to the PA.

15. The WTRU of claim 14 wherein the digital pre-distortion compensation module comprises:

(i) a power estimation unit coupled to each of the real and imaginary signal paths, the power estimation unit being configured to generate a power estimation signal based on the magnitude of the real and imaginary signal components;

(ii) a first multiplier being configured to multiply the power estimation signal with the first mapped TPC signal to generate a first resulting product signal;

(iii) at least one look up table (LUT) being configured to generate an amplitude compensation signal in response to receiving the first resulting product signal; and

(iv) a phase distortion compensation unit being configured to generate a phase compensation signal in response to receiving the first resulting product signal.

16. The WTRU of claim 15 wherein the digital pre-distortion compensation module further comprises:

(v) a second multiplier being configured to multiply the amplitude compensation signal with the real signal component to generate a second resulting product signal;

(vi) a first adder being configured to add the second resulting product signal to the real signal component to generate an amplitude compensated real signal component;

(vii) a third multiplier being configured to multiply the amplitude compensation signal with the imaginary signal component to generate a third resulting product signal; and

(viii) a second adder being configured to add the third resulting product signal to the imaginary signal component to generate an amplitude compensated imaginary signal component.

17. The WTRU of claim 16 wherein the digital pre-distortion compensation module further comprises:

(ix) a fourth multiplier being configured to multiply the phase compensation signal with the amplitude compensated real signal component to generate a fourth resulting product signal;

(x) a third adder being configured to add the fourth resulting product signal to the amplitude compensated imaginary signal component;

(xi) a fifth multiplier being configured to multiply the phase compensation signal with the amplitude compensated imaginary signal component to generate a fifth resulting product signal; and

(xii) a fourth adder being configured to subtract the fifth resulting product signal from the amplitude compensated real signal component.

18. The WTRU of claim 15 wherein the amplitude compensation signal is used to correct at least one impaired amplitude characteristic associated with the PA.

19. The WTRU of claim 15 wherein the phase compensation signal is used to correct at least one impaired phase characteristic associated with the PA.

20. The WTRU of claim 14 wherein the second mapped TPC signal is used to adjust the gain of the PA such that the PA does not operate in a nonlinear fashion.

21. An integrated circuit (IC) for transmitting at least one wireless communication signal to a base station (BS) which is configured to generate a transmit power control (TPC) signal in response to receiving the wireless communication signal, the IC comprising:

(a) a digital pre-distortion compensation module having real and imaginary signal paths which are configured to receive and process respective real and imaginary signal components used to generate the wireless communication signal;

(b) an analog radio transmitter including a power amplifier (PA), the analog radio transmitter being configured to receive the processed real and imaginary signal components and, in response, generating a communication signal which is input to the PA, the PA being configured to amplify the generated communication signal, wherein the amplified communication signal is emitted from the IC as the wireless communication signal; and

(c) a controller in communication with the digital pre-distortion compensation module and the PA, the controller being configured to control the characteristics of the wireless communication signal based on the TPC signal generated by the BS.

22. The IC of claim 21 further comprising:

(d) a modem having real and imaginary signal paths and being configured to generate the real and imaginary signal components, receive the TPC signal and to pass the TPC signal to the controller.

23. The IC of claim 22 further comprising:

(e) a first low pass filter (LPF) which couples the real signal path of the modem to the real signal path of the digital pre-distortion compensation module; and

(f) a second LPF which couples the imaginary signal path of the modem to the imaginary signal path of the digital pre-distortion compensation module.

24. The IC of claim 23 wherein the controller includes a TPC mapping unit which receives the TPC signal from the modem, the TPC mapping unit being configured to output a first mapped TPC signal to the digital pre-distortion compensation module and a second mapped TPC signal to the PA.

25. The IC of claim 24 wherein the digital pre-distortion compensation module comprises:

(i) a power estimation unit coupled to each of the real and imaginary signal paths, the power estimation unit being configured to generate a power estimation signal based on the magnitude of the real and imaginary signal components;

(ii) a first multiplier being configured to multiply the power estimation signal with the first mapped TPC signal to generate a first resulting product signal;

(iii) at least one look up table (LUT) being configured to generate an amplitude compensation signal in response to receiving the first resulting product signal; and

(iv) a phase distortion compensation unit being configured to generate a phase compensation signal in response to receiving the first resulting product signal.

26. The IC of claim 25 wherein the digital pre-distortion compensation module further comprises:

(v) a second multiplier being configured to multiply the amplitude compensation signal with the real signal component to generate a second resulting product signal;

(vi) a first adder being configured to add the second resulting product signal to the real signal component to generate an amplitude compensated real signal component;

(vii) a third multiplier being configured to multiply the amplitude compensation signal with the imaginary signal component to generate a third resulting product signal; and

(viii) a second adder being configured to add the third resulting product signal to the imaginary signal component to generate an amplitude compensated imaginary signal component.

27. The IC of claim 26 wherein the digital pre-distortion compensation module further comprises:

(ix) a fourth multiplier being configured to multiply the phase compensation signal with the amplitude compensated real signal component to generate a fourth resulting product signal;

(x) a third adder being configured to add the fourth resulting product signal to the amplitude compensated imaginary signal component;

(xi) a fifth multiplier being configured to multiply the phase compensation signal with the amplitude compensated imaginary signal component to generate a fifth resulting product signal; and

(xii) a fourth adder being configured to subtract the fifth resulting product signal from the amplitude compensated real signal component.

28. The IC of claim 25 wherein the amplitude compensation signal is used to correct at least one impaired amplitude characteristic associated with the PA.

29. The IC of claim 25 wherein the phase compensation signal is used to correct at least one impaired phase characteristic associated with the PA.

30. The IC of claim 24 wherein the second mapped TPC signal is used to adjust the gain of the PA such that the PA does not operate in a nonlinear fashion.

31. In a wireless communication system for transmitting at least one wireless communication signal generated from real and imaginary signal components, a digital pre-distortion compensation module comprising:

(a) real and imaginary signal paths which are configured to receive and process the real and imaginary signal components;

(b) a power estimation unit coupled to each of the real and imaginary signal paths, the power estimation unit being configured to generate a power estimation signal based on the magnitude of the real and imaginary signal components;

(c) a first multiplier being configured to multiply the power estimation signal with a transmit power control (TPC) signal to generate a first resulting product signal, the TPC signal being associated with the power of the wireless communication signal;

(d) at least one look up table (LUT) being configured to generate an amplitude compensation signal in response to receiving the first resulting product signal; and

(e) a phase distortion compensation unit being configured to generate a phase compensation signal in response to receiving the first resulting product signal.

32. The digital pre-distortion compensation module of claim 31 further comprising:

(f) a second multiplier being configured to multiply the amplitude compensation signal with the real signal component to generate a second resulting product signal;

(g) a first adder being configured to add the second resulting product signal to the real signal component to generate an amplitude compensated real signal component;

(h) a third multiplier being configured to multiply the amplitude compensation signal with the imaginary signal component to generate a third resulting product signal; and

(i) a second adder being configured to add the third resulting product signal to the imaginary signal component to generate an amplitude compensated imaginary signal component.

33. The digital pre-distortion compensation module of claim 32 further comprising:

(j) a fourth multiplier being configured to multiply the phase compensation signal with the amplitude compensated real signal component to generate a fourth resulting product signal;

(k) a third adder being configured to add the fourth resulting product signal to the amplitude compensated imaginary signal component;

(l) a fifth multiplier being configured to multiply the phase compensation signal with the amplitude compensated imaginary signal component to generate a fifth resulting product signal; and

(m) a fourth adder being configured to subtract the fifth resulting product signal from the amplitude compensated real signal component.

34. In a wireless communication system for transmitting at least one wireless communication signal generated from real and imaginary signal components, a digital baseband (DBB) transmitter comprising:

(a) real and imaginary signal paths which are configured to receive and process the real and imaginary signal components;

(b) a power estimation unit coupled to each of the real and imaginary signal paths, the power estimation unit being configured to generate a power estimation signal based on the magnitude of the real and imaginary signal components;

(c) a first multiplier being configured to multiply the power estimation signal with a transmit power control (TPC) signal to generate a first resulting product signal, the TPC signal being associated with the power of the wireless communication signal;

(d) at least one look up table (LUT) being configured to generate an amplitude compensation signal in response to receiving the first resulting product signal; and

(e) a phase distortion compensation unit being configured to generate a phase compensation signal in response to receiving the first resulting product signal.

35. The DBB transmitter of claim 34 further comprising:

(f) a second multiplier being configured to multiply the amplitude compensation signal with the real signal component to generate a second resulting product signal;

(g) a first adder being configured to add the second resulting product signal to the real signal component to generate an amplitude compensated real signal component;

(h) a third multiplier being configured to multiply the amplitude compensation signal with the imaginary signal component to generate a third resulting product signal; and

(i) a second adder being configured to add the third resulting product signal to the imaginary signal component to generate an amplitude compensated imaginary signal component.

36. The DBB transmitter of claim 35 further comprising:

(j) a fourth multiplier being configured to multiply the phase compensation signal with the amplitude compensated real signal component to generate a fourth resulting product signal;

(k) a third adder being configured to add the fourth resulting product signal to the amplitude compensated imaginary signal component;

(l) a fifth multiplier being configured to multiply the phase compensation signal with the amplitude compensated imaginary signal component to generate a fifth resulting product signal; and

(m) a fourth adder being configured to subtract the fifth resulting product signal from the amplitude compensated real signal component.

37. In a wireless communication system for transmitting at least one wireless communication signal generated from real and imaginary signal components, a wireless transmit/receive unit (WTRU) comprising:

(a) real and imaginary signal paths which are configured to receive and process the real and imaginary signal components;

(b) a power estimation unit coupled to each of the real and imaginary signal paths, the power estimation unit being configured to generate a power estimation signal based on the magnitude of the real and imaginary signal components;

(c) a first multiplier being configured to multiply the power estimation signal with a transmit power control (TPC) signal to generate a first resulting product signal, the TPC signal being associated with the power of the wireless communication signal;

(d) at least one look up table (LUT) being configured to generate an amplitude compensation signal in response to receiving the first resulting product signal; and

(e) a phase distortion compensation unit being configured to generate a phase compensation signal in response to receiving the first resulting product signal.

38. The WTRU of claim 37 further comprising:

(f) a second multiplier being configured to multiply the amplitude compensation signal with the real signal component to generate a second resulting product signal;

(g) a first adder being configured to add the second resulting product signal to the real signal component to generate an amplitude compensated real signal component;

(h) a third multiplier being configured to multiply the amplitude compensation signal with the imaginary signal component to generate a third resulting product signal; and

(i) a second adder being configured to add the third resulting product signal to the imaginary signal component to generate an amplitude compensated imaginary signal component.

39. The WTRU of claim 38 further comprising:

(j) a fourth multiplier being configured to multiply the phase compensation signal with the amplitude compensated real signal component to generate a fourth resulting product signal;

(k) a third adder being configured to add the fourth resulting product signal to the amplitude compensated imaginary signal component;

(l) a fifth multiplier being configured to multiply the phase compensation signal with the amplitude compensated imaginary signal component to generate a fifth resulting product signal; and

(m) a fourth adder being configured to subtract the fifth resulting product signal from the amplitude compensated real signal component.

40. In a wireless communication system for transmitting at least one wireless communication signal generated from real and imaginary signal components, an integrated circuit (IC) comprising:

(a) real and imaginary signal paths which are configured to receive and process the real and imaginary signal components;

(b) a power estimation unit coupled to each of the real and imaginary signal paths, the power estimation unit being configured to generate a power estimation signal based on the magnitude of the real and imaginary signal components;

(c) a first multiplier being configured to multiply the power estimation signal with a transmit power control (TPC) signal to generate a first resulting product signal, the TPC signal being associated with the power of the wireless communication signal;

(d) at least one look up table (LUT) being configured to generate an amplitude compensation signal in response to receiving the first resulting product signal; and

(e) a phase distortion compensation unit being configured to generate a phase compensation signal in response to receiving the first resulting product signal.

41. The IC of claim 40 further comprising:

(f) a second multiplier being configured to multiply the amplitude compensation signal with the real signal component to generate a second resulting product signal;

(g) a first adder being configured to add the second resulting product signal to the real signal component to generate an amplitude compensated real signal component;

(h) a third multiplier being configured to multiply the amplitude compensation signal with the imaginary signal component to generate a third resulting product signal; and

(i) a second adder being configured to add the third resulting product signal to the imaginary signal component to generate an amplitude compensated imaginary signal component.

42. The IC of claim 41 further comprising:

(j) a fourth multiplier being configured to multiply the phase compensation signal with the amplitude compensated real signal component to generate a fourth resulting product signal;

(k) a third adder being configured to add the fourth resulting product signal to the amplitude compensated imaginary signal component;

(l) a fifth multiplier being configured to multiply the phase compensation signal with the amplitude compensated imaginary signal component to generate a fifth resulting product signal; and

(m) a fourth adder being configured to subtract the fifth resulting product signal from the amplitude compensated real signal component.

43. In a wireless communication system for transmitting at least one wireless communication signal generated from real and imaginary signal components, a method of adjusting at least one characteristic of the wireless communication signal, the method comprising:

(a) generating a power estimation signal based on the magnitude of the real and imaginary signal components;

(b) multiplying the power estimation signal with a transmit power control (TPC) signal to generate a first resulting product signal, the TPC signal being associated with the power of the wireless communication signal;

(c) generating an amplitude compensation signal in response to receiving the first resulting product signal;

(d) multiplying the amplitude compensation signal with the real signal component to generate a second resulting product signal;

(e) adding the second resulting product signal to the real signal component to generate an amplitude compensated real signal component;

(f) multiplying the amplitude compensation signal with the imaginary signal component to generate a third resulting product signal; and

(g) adding the third resulting product signal to the imaginary signal component to generate an amplitude compensated imaginary signal component.

44. The method of claim 43 further comprising:

(h) generating a phase compensation signal in response to receiving the first resulting product signal;

(i) multiplying the phase compensation signal with the amplitude compensated real signal component to generate a fourth resulting product signal;

(j) adding the fourth resulting product signal to the amplitude compensated imaginary signal component;

(k) multiplying the phase compensation signal with the amplitude compensated imaginary signal component to generate a fifth resulting product signal; and

(l) subtracting the fifth resulting product signal from the amplitude compensated real signal component.

45. A wireless communication system for transmitting and adjusting at least one characteristic of a wireless communication signal generated from real and imaginary signal components, the system comprising:

(a) means for generating a power estimation signal based on the magnitude of the real and imaginary signal components;

(b) means for multiplying the power estimation signal with a transmit power control (TPC) signal to generate a first resulting product signal, the TPC signal being associated with the power of the wireless communication signal;

(c) means for generating an amplitude compensation signal in response to receiving the first resulting product signal;

(d) means for multiplying the amplitude compensation signal with the real signal component to generate a second resulting product signal;

(e) means for adding the second resulting product signal to the real signal component to generate an amplitude compensated real signal component;

(f) means for multiplying the amplitude compensation signal with the imaginary signal component to generate a third resulting product signal; and

(g) means for adding the third resulting product signal to the imaginary signal component to generate an amplitude compensated imaginary signal component.

46. The system of claim 45 further comprising:

(h) means for generating a phase compensation signal in response to receiving the first resulting product signal;

(i) means for multiplying the phase compensation signal with the amplitude compensated real signal component to generate a fourth resulting product signal;

(j) means for adding the fourth resulting product signal to the amplitude compensated imaginary signal component;

(k) means for multiplying the phase compensation signal with the amplitude compensated imaginary signal component to generate a fifth resulting product signal; and

(l) means for subtracting the fifth resulting product signal from the amplitude compensated real signal component.

47. In a wireless communication system including a wireless transmit/receive unit (WTRU) for transmitting a wireless communication signal generated from real and imaginary signal components to a base station (BS), the WTRU including a digital pre-distortion compensation module for receiving and processing real and imaginary signal components, and a power amplifier (PA), a method comprising:

(a) the BS receiving a wireless communication signal from the WTRU;

(b) the WTRU receiving a transmit power control (TPC) signal generated by the base station in response to step (a);

(c) the WTRU generating a first mapped TPC signal and a second mapped TPC signal in response to step (b);

(d) the amplitude and phase characteristics of each of the signal components being adjusted in response to the pre-distortion compensation module receiving the first mapped TPC signal; and

(e) the gain of the PA is adjusted in response to the PA receiving the second mapped TPC signal such that the PA does not operate in a nonlinear fashion.

48. A wireless communication system for transmitting a wireless communication signal generated from real and imaginary signal components, the system comprising:

(a) a wireless transmit/receive unit (WTRU) including a power amplifier (PA); and

(b) a base station (BS) configured to receive a wireless communication signal from the WTRU, wherein:

(i) a transmit power control (TPC) signal is generated by the BS; and

(ii) a first mapped TPC signal and a second mapped TPC signal are generated by the WTRU in response to receiving the TPC signal generated by the BS, wherein amplitude and phase characteristics of each of the signal components used to generate the wireless communication signal are adjusted in response to the first

mapped TPC signal, and the gain of the PA is adjusted in response to the second mapped TPC signal such that the PA does not operate in a nonlinear fashion.